

APPENDIX C

Underwater Benthic Habitat Survey Report



**PWGSC PROJECT #R.075061.002
UNDERWATER BENTHIC HABITAT SURVEY
ALMA DFO-SCH
ALMA, NEW BRUNSWICK

FINAL REPORT**

Submitted to:
Public Works and Government Services Canada
Saint John, New Brunswick

Submitted by:
Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited
Saint John, New Brunswick

August 2015

TE131446.1000



18 August, 2015

TE131446.1000

Mr. Jason Keys
Environmental Officer
Environmental Services
Public Works and Government Services Canada
189 Prince William Street
Saint John, New Brunswick
E2L 2B9

Dear Mr. Keys:

Re: Underwater Benthic Habitat Survey at the Alma Fisheries and Oceans Canada Small Craft Harbour, Alma, New Brunswick – Final Report

Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler), is pleased to provide Public Works and Government Services Canada with the findings of an Underwater Benthic Habitat Survey undertaken within the footprint of a proposed breakwater extension and dredge areas at the Alma Fisheries and Oceans Canada – Small Craft Harbour in Alma, New Brunswick.

Amec Foster Wheeler appreciates the opportunity to provide services to your organization. Please do not hesitate to call if you have any questions regarding this or any other matter.

Respectfully submitted,

**Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited**

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1.0 INTRODUCTION

At the request of Public Works and Government Services Canada (PWGSC), an Underwater Benthic Habitat Survey (UBHS) program was completed on 13 July, 2015 within the footprint of a breakwater extension and dredge area at the Alma Fisheries and Oceans Canada (DFO) – Small Craft Harbour (SCH) in Alma, New Brunswick.

2.0 SCOPE AND METHODOLOGY

Qualitative and quantitative observations were obtained from the footprint of the breakwater extension and dredge areas using video survey techniques to map substrate types and document macrofaunal and macrofloral species presence and abundance. Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler) contracted Diversified Divers Inc. to perform the diving and video surveillance services. An Amec Foster Wheeler representative was on-site to guide the dive crew in the event that any issues arose and to obtain supporting habitat and biological information.

A total of 465 metres (m) of video surveillance was divided into two transects (T1 and T2) and four transect tie lines (TT1 to TT4) of various lengths from the footprint of the breakwater extension and dredge areas at the Alma DFO-SCH (Figure 2.1).

A handheld Global Positioning System (GPS) was used to locate the pre-determined start and finish points of the transects.

The survey of the transects required the use of a video camera, operated by a Canadian Standards Association (CSA)-certified diver. Video at the Alma DFO-SCH were collected at low tide with all but the first 10 m of T-1 completed in dry conditions. As much as was practical, the underwater video survey encompassed a span of approximately 1m on either side of the transect line. Seabed characterization involved field observations made by the field crew and a review of the video survey recording. Observations along the video transect were made for every 5 m segment.

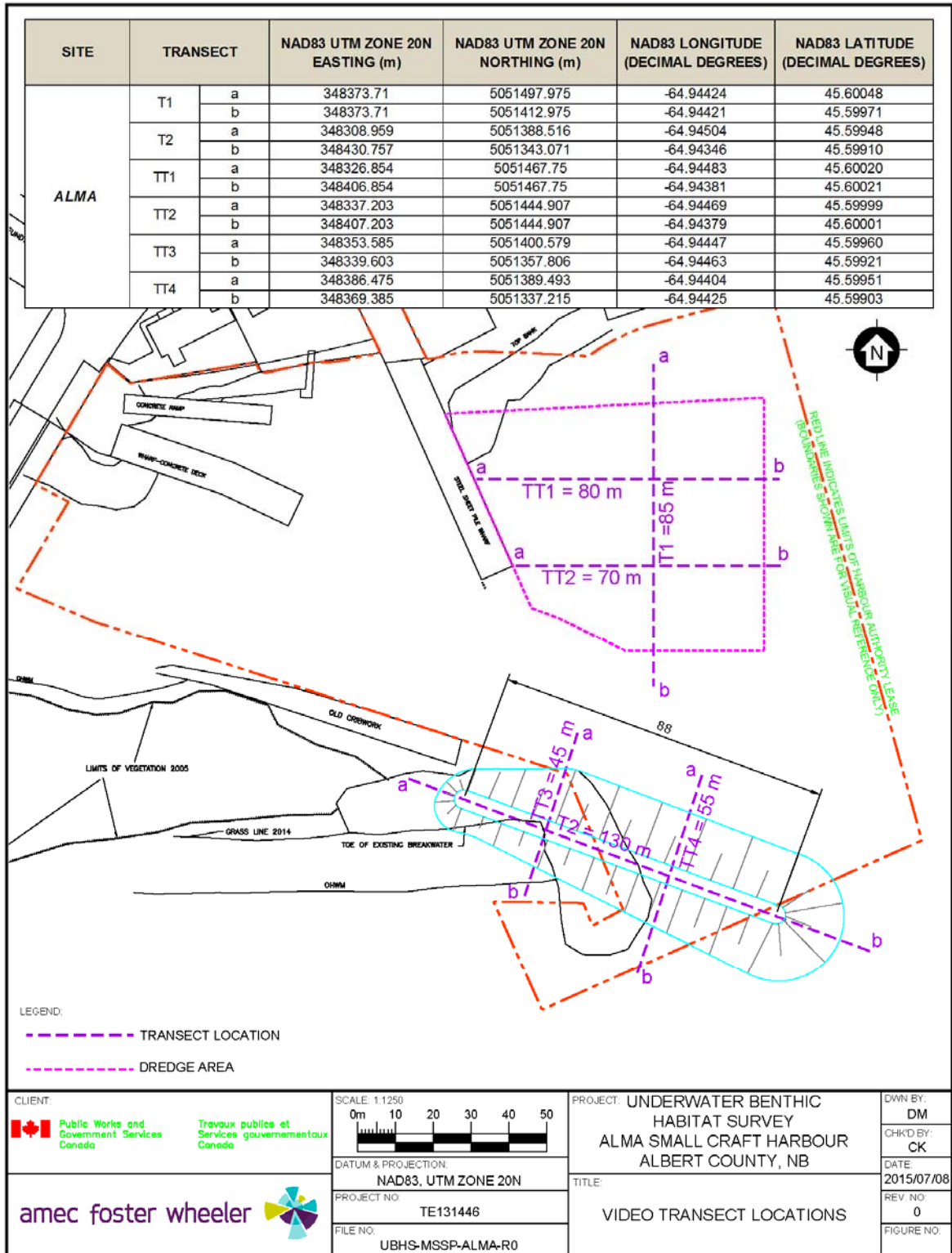


Figure 2.1 Benthic Transect Locations – Alma DFO-SCH, Alma, New Brunswick

3.0 UNDERWATER HABITAT SURVEY RESULTS

The results of the transect surveys for the proposed project footprint are presented in Appendix A (Tables A.1 to A.6), including the following information for each 5 m increment of transect line:

- visual determination of substrate type (in order of dominance);
- macrofaunal species identification and abundance; and
- macrofloral species identification and percent coverage.

A summary of the information provided in Tables A.1 to A.6 (Appendix A) is described in the following paragraphs. An annotated species list has been included in Appendix B. Photographs of the area at low tide have been included in Appendix C.

For the purposes of the video survey review and macrofaunal species identification and enumeration, four categories were developed to characterize the observed abundance levels. The categories are as follows:

A = Abundant

Numerous (not quantifiable) observations made throughout the entire 5 m segment.

C = Common

Numerous (not quantifiable) observations made intermittently along the 5 m segment.

O = Occasional

Quantifiable observations made intermittently along the 5 m segment.

U = Uncommon

Quantifiable observations made infrequently along the 5 m segment.

Observations of macrofaunal life were noted along three of the six transects (T1, TT1, and TT2), as further described in this section.

Macrofloral life was noted in four of the six transects (T1, TT1, TT2 and TT3) as further described below and in the associated tables in Appendix A (where encountered). Macrofloral debris (i.e., detritus from macrofloral species) was noted along segments of two transects (T2 and TT3).

3.1 Transect 1 (T1)

Transect 1 (T1) was 85 m long, starting in the channel proceeding north to the upper intertidal zone (Figure 2.1).

Substrate:

The substrate along the first half of the transect was predominantly composed of rock with lesser amounts of cobble, sand, and gravel. The second half of the transect was predominantly cobble with lesser amounts of gravel, rock, and sand.

Macrofauna:

Macrofaunal life was generally devoid along T1 with Northern rock barnacle (*Semibalanus balanoides*) noted as abundant in only the 15-20 and 20-25 m segments. Shell hash was noted in the first three segments of the transect.

Macroflora:

Macrofloral life was noted the first half of the transect. Soft sour weed (*Desmarestia viridis*), green algae (*Spongomorpha* sp. and *Enteromorpha* sp.), and bladderwrack (*Fucus vesiculosus*) were noted with coverage of 5-25% in the first two segments of the transect. From the 10-15 m to the 45-50 m segments bladderwrack was noted in six segments with cover between 10-65% and *Spongomorpha* sp. was noted in two segments with a cover between 5 and 10%. No flora was noted between the 50-55 and 80-85 m segments.

3.2 Transect 2 (T2)

Transect 2 (T2) was 130 m long starting on top of the existing armourstone breakwater and proceeded in east-southeast to the lower intertidal zone (Figure 2.1).

Substrate:

The substrate along the existing breakwater was comprised of boulder except for a 20 m portion that crossed the beach and was predominantly sand. The substrate along the seabed was predominantly cobble (35-80%) with lesser amounts of rock, gravel, and sand.

Macrofauna:

No macrofaunal life was observed along the entire length of T2. Shell hash was noted between 20 and 40 m.

Macroflora:

No aquatic macrofloral life was observed along the entire length of T2. Terrestrial shrubs and lichens were noted between the 0 and 20 m segments and the 45 to 65 m segments.

3.3 Transect Tie Line 1 (TT1)

Transect tie line 1 (TT1) was 80 m long. This transect started in the mid-intertidal and proceeded west to the steel sheet pile wharf. (Figure 2.1).

Substrate:

The substrate was predominantly sand (25-90%) with varying amounts of rock, cobble, and silt.

Macrofauna:

Macrofaunal life in TT1 was restricted to a common occurrence of the Northern rock barnacle in the 10-15 m segment.

Macroflora:

Spongomorpha sp. was noted in the 25-30, 30-35, and 40-45 m segments with 5% coverage.

3.4 Transect Tie Line 2 (TT2)

Transect tie line 2 (TT2) was 70 m long. This transect started in the mid-intertidal and proceeded west to the steel sheet pile wharf. (Figure 2.1).

Substrate:

The substrate was predominantly cobble (10-65%) with varying amounts of sand, silt, rock, and boulder.

Macrofauna:

Macrofaunal life in TT2 was restricted to a common occurrence of the Northern rock barnacle in the 0-5 m segment.

Macroflora:

Bladderwrack was noted in 11 of the 14 segments of the transect with a cover between 5 and 40%. *Spongomorpha* sp. was observed in the 25-30 m, segment with 5% cover and rockweed (*Ascophyllum nodosum*) was noted in the 15-20 m segment with 5% cover.

3.5 Transect Tie Line 3 (TT3)

Transect tie line 3 (TT3) was 45 m long. It was filmed in an approximate south to north orientation, from the intertidal zone over the existing breakwater and back to the intertidal zone (Figure 2.1).

Substrate:

The substrate in the intertidal areas (0-15 m and 40-45 m) was predominantly sand with lesser amount of cobble. The substrate along the breakwater was comprised of boulder.

Macrofauna:

No macrofauna was noted in TT3.

Macroflora:

Spongomorpha sp. was noted in the 34-40 m segment with 5% coverage and macrofloral debris was noted in three segment (0-15 m) with coverage between 5 and 35%. In addition terrestrial shrubs and lichens were observed.

3.6 Transect Tie Line 4 (TT4)

Transect tie line 4 (TT4) was 55 m long. It was filmed in an approximate south to north orientation in the intertidal zone approximately 5 m from the toe of the breakwater (Figure 2.1).

Substrate:

The substrate was a mix of cobble (35-70%) and sand (10-60%) with lesser amounts of gravel and rock.

Macrofauna:

No macrofauna was noted in TT4.

Macroflora:

No macroflora was noted in TT4.

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The diving crew was directed by an on-site Amec Foster Wheeler representative (Mr. Bruce Moore, B.Sc.) who is experienced in data collection for environmental assessment project components. Mr. Moore was responsible for the data collection and overall data quality as well as for ensuring that all standard operating procedures were followed and that adequate health and safety measures were taken.

A Project Reviewer (Ms. Kerry Higgins, B.Sc, EP) has reviewed this report prior to its release. The limitations of this document are provided in Appendix D.

5.0 SUMMARY

Characterization of the substrate and benthic communities along six transects within the footprint of a breakwater extension and dredge areas at the Alma DFO–SCH in Alma, New Brunswick was completed using a combination of visual field observations and underwater video survey techniques. All of the collected video except for the first 10 m of T1 was completed at low tide.

The intertidal zone surveyed was a mix of sand, cobble, and rock, with any of the three possible as the predominant substrate depending on the location. Gravel and silt were noted throughout the transects but generally were not a major component of the substrate. The existing breakwater which was surveyed in T2 and TT3 was composed almost entirely of boulders with gravel and sand noted in discrete locations.

Macrofaunal life was observed in three of the six transects, but was limited to a common or abundant occurrence of Northern rock barnacle in only 4 segments of the entire survey.

Macrofloral life was observed in five of the six transects, but was generally sparse. The greatest diversity was observed within the channel with four different algal species. In the remainder of the transects bladderwrack was the predominant species with coverage ranging between 5 and 65%. The green alga, *Spongomorpha* sp. was the next most prevalent species but was noted in only six 6 segments with coverage never higher than 5%. Rockweed was noted in only one segment within the surveyed area with a cover of 5%.



6.0 CLOSING

This document has been prepared and reviewed by the following people:

Prepared by:

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Bruce Moore, B.Sc.
Marine Biologist /
Intermediate Project Professional

Reviewed by:

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Kerry Higgins, B.Sc., EP
NB/PE Operations Manager /
Senior Project Professional



APPENDIX A
Transcript of Video and On-Site Observations

Table A.1 85 m Survey – Transect T1, 13 July, 2015

| Transect Distance (m) | Transect Tag Numbers | Substrate (Estimated % Coverage) | Macrofaunal Life Observed (Estimated Abundances*) | Macrofloral Life Observed (Estimated % Coverage) |
|------------------------|----------------------|--|--|--|
| 0-5 T1 Start | 0-5 | Rock (50%); Gravel (25%); Sand (25%) | Shell hash | Soft sour weed (<i>Desmarestia viridis</i>) (25%); Bladderwrack (<i>Fucus vesiculosus</i>) (5%); Green alga (<i>Spongomorpha</i> sp.) (5%) |
| 5-10 | 5-10 | Rock (75%); Sand (15%); Gravel (10%) | Shell hash | Soft sour weed (<i>Desmarestia viridis</i>) (30%); Green alga (<i>Enteromorpha</i> sp.) (10%); Bladderwrack (<i>Fucus vesiculosus</i>) (5%); Green alga (<i>Spongomorpha</i> sp.) (5%) |
| 10-15 | 10-15 | Silt (45%); Sand (40%); Cobble (10%); Rock (5%) | Shell hash | Bladderwrack (<i>Fucus vesiculosus</i>) (15%) |
| 15-20 | 15-20 | Rock (65%); Silt (15%); Cobble (10%); Sand (10%) | Northern rock barnacle (<i>Semibalanus balanoides</i>) (A) | Bladderwrack (<i>Fucus vesiculosus</i>) (65%) |
| 20-25 | 20-25 | Rock (50%); Silt (30%); Sand (15%); Cobble (5%) | Northern rock barnacle (<i>Semibalanus balanoides</i>) (A) | Bladderwrack (<i>Fucus vesiculosus</i>) (45%); Green alga (<i>Spongomorpha</i> sp.) (10%) |
| 25-30 | 25-30 | Rock (70%); Cobble (30%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (35%) |
| 30-35 | 30-35 | Rock (70%); Cobble (30%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (15%) |
| 35-40 | 35-40 | Rock (60%); Cobble (25%); Gravel (15%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (10%) |
| 40-45 | 40-45 | Rock (30%); Cobble (30%); Gravel (20%); Sand (20%) | No fauna observed | No flora observed |
| 45-50 | 45-50 | Gravel (40%); Cobble (25%); Rock (20%); Sand (15%) | No fauna observed | Green alga (<i>Spongomorpha</i> sp.) (5%) |
| 50-55 | 50-55 | Cobble (45%); Gravel (25%); Rock (20%); Sand (15%) | No fauna observed | No flora observed |
| 55-60 | 55-60 | Cobble (40%); Gravel (25%); Rock (15%); Sand (10%) | No fauna observed | No flora observed |
| 60-65 | 60-65 | Cobble (40%); Gravel (25%); Rock (15%); Sand (10%) | No fauna observed | No flora observed |
| 65-70 | 65-70 | Cobble (55%); Gravel (20%); Rock (10%); Sand (10%); Boulder (5%) | No fauna observed | No flora observed |
| 70-75 | 70-75 | Cobble (40%); Gravel (30%); Sand (25%); Rock (5%) | No fauna observed | No flora observed |
| 75-80 | 75-80 | Gravel (35%); Sand (25%); Cobble (20%); Rock (20%) | No fauna observed | No flora observed |
| 80-85 T1 End | 80-85 | Rock (35%); Cobble (25%); Gravel (20%); Sand (20%) | No fauna observed | No flora observed |

*A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).

Table A.2 130 m Survey – Transect T2, 13 July, 2015

| Transect Distance (m) | Transect Tag Numbers | Substrate (Estimated % Coverage) | Macrofaunal Life Observed (Estimated Abundances*) | Macrofloral Life Observed (Estimated % Coverage) |
|--------------------------|----------------------|---|---|--|
| 0-5 T2 Start | 0-5 | Boulder (100%) | No fauna observed | Terrestrial shrubs |
| 5-10 | 5-10 | Boulder (100%) | No fauna observed | Terrestrial shrubs |
| 10-15 | 10-15 | Boulder (100%) | No fauna observed | Terrestrial shrubs |
| 15-20 | 15-20 | Boulder (100%) | No fauna observed | Terrestrial shrubs |
| 20-25 | 20-25 | Sand (95%); Cobble (5%) | Shell hash | Macrofloral debris (20%) |
| 25-30 | 25-30 | Sand (95%); Cobble (5%) | Shell hash | Macrofloral debris (20%) |
| 30-35 | 30-35 | Sand (95%); Cobble (5%) | Shell hash | Macrofloral debris (40%) |
| 35-40 | 35-40 | Sand (90%); Cobble (5%); Boulder (5%) | Shell hash | Macrofloral debris (20%) |
| 40-45 | 40-45 | Boulder (95%); Sand (5%) | No fauna observed | No flora observed |
| 45-50 | 45-50 | Boulder (100%) | No fauna observed | Lichens (10%) |
| 50-55 | 50-55 | Boulder (100%) | No fauna observed | Lichens (10%) |
| 55-60 | 55-60 | Boulder (100%) | No fauna observed | Lichens (10%) |
| 60-65 | 60-65 | Boulder (100%) | No fauna observed | Lichens (10%) |
| 65-70 | 65-70 | Boulder (60%); Gravel (20%); Cobble (15%); Rock (5%) | No fauna observed | No flora observed |
| 70-75 | 70-75 | Cobble (35%); Boulder (25%); Rock (25%); Gravel (15%) | No fauna observed | No flora observed |
| 75-80 | 75-80 | Cobble (80%); Gravel (10%); Rock (10%) | No fauna observed | No flora observed |
| 80-85 | 80-85 | Cobble (70%); Rock (15%); Sand (15%) | No fauna observed | No flora observed |
| 85-90 | 85-90 | Cobble (80%); Sand (15%); Rock (5%) | No fauna observed | No flora observed |
| 90-95 | 90-95 | Cobble (75%); Sand (20%); Rock (5%) | No fauna observed | No flora observed |
| 95-100 | 95-100 | Cobble (65%); Sand (25%); Rock (5%) | No fauna observed | No flora observed |
| 100-105 | 100-105 | Cobble (65%); Sand (25%); Rock (5%) | No fauna observed | No flora observed |
| 105-110 | 105-110 | Cobble (65%); Sand (25%); Rock (5%) | No fauna observed | No flora observed |
| 110-115 | 110-115 | Cobble (65%); Sand (25%); Rock (5%) | No fauna observed | No flora observed |
| 115-120 | 115-120 | Cobble (50%); Sand (40%); Rock (10%) | No fauna observed | No flora observed |
| 120-125 | 120-125 | Cobble (50%); Sand (40%); Rock (10%) | No fauna observed | No flora observed |
| 125-130 T2 End | 125-130 | Cobble (50%); Sand (40%); Rock (10%) | No fauna observed | No flora observed |

*A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).

Table A.3 80 m Survey – Transect TT1, 20 July, 2015

| Transect Distance (m) | Transect Tag Numbers | Substrate (Estimated % Coverage) | Macrofaunal Life Observed (Estimated Abundances*) | Macrofloral Life Observed (Estimated % Coverage) |
|-----------------------|----------------------|---|--|--|
| 0-5 TT1 Start | 0-5 | Sand (50%); Cobble (35%); Silt (10%); Rock (5%) | No fauna observed | No flora observed |
| 5-10 | 5-10 | Cobble (60%); Sand (30%); Silt (5%); Rock (5%) | No fauna observed | No flora observed |
| 10-15 | 10-15 | Sand (65%); Cobble (35%); Silt (5%); Rock (5%) | Northern rock barnacle (<i>Semibalanus balanoides</i>) (C) | No flora observed |
| 15-20 | 15-20 | Sand (55%); Cobble (25%); Silt (5%); Rock (5%) | No fauna observed | No flora observed |
| 20-25 | 20-25 | Sand (45%); Cobble (45%); Silt (5%); Rock (5%) | No fauna observed | No flora observed |
| 25-30 | 25-30 | Cobble (65%); Sand (25%); Silt (5%); Rock (5%) | No fauna observed | Green alga (<i>Spongomorpha</i> sp.) (5%) |
| 30-35 | 30-35 | Cobble (50%); Sand (35%); Rock (10%); Silt (5%) | No fauna observed | Green alga (<i>Spongomorpha</i> sp.) (5%) |
| 35-40 | 35-40 | Sand (50%); Cobble (40%); Silt (5%); Rock (5%) | No fauna observed | No flora observed |
| 40-45 | 40-45 | Sand (45%); Cobble (40%); Rock (10%); Silt (5%) | No fauna observed | Green alga (<i>Spongomorpha</i> sp.) (5%) |
| 45-50 | 45-50 | Sand (70%); Cobble (25%); Silt (5%) | No fauna observed | No flora observed |
| 50-55 | 50-55 | Sand (70%); Cobble (25%); Silt (5%) | No fauna observed | No flora observed |
| 55-60 | 55-60 | Sand (70%); Cobble (20%); Rock (5%); Silt (5%) | No fauna observed | No flora observed |
| 60-65 | 60-65 | Sand (50%); Cobble (35%); Rock (10%); Silt (5%) | No fauna observed | No flora observed |
| 65-70 | 65-70 | Sand (40%); Cobble (30%); Rock (25%); Silt (5%) | No fauna observed | No flora observed |
| 70-75 | 70-75 | Sand (85%); Cobble (5%); Rock (5%); Silt (5%) | No fauna observed | No flora observed |
| 75-80 TT1 End | 75-80 | Sand (90%); Rock (5%); Silt (5%) | No fauna observed | No flora observed |

*A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).

Table A.4 70 m Survey – Transect TT2, 13 July, 2015

| Transect Distance (m) | Transect Tag Numbers | Substrate (Estimated % Coverage) | Macrofaunal Life Observed (Estimated Abundances*) | Macrofloral Life Observed (Estimated % Coverage) |
|-------------------------|----------------------|---|--|--|
| 0-5 TT2 Start | 0-5 | Cobble (65%); Rock (20%); Sand (15%) | Northern rock barnacle (<i>Semibalanus balanoides</i>) (A) | Bladderwrack (<i>Fucus vesiculosus</i>) (10%) |
| 5-10 | 5-10 | Cobble (45%); Sand (35%); Rock (15%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (5%) |
| 10-15 | 10-15 | Sand (55%); Cobble (30%); Rock (10%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (5%) |
| 15-20 | 15-20 | Cobble (55%); Sand (35%); Boulder (10%); Rock (5%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (5%); Rockweed (<i>Ascophyllum nodosum</i>) (5%) |
| 20-25 | 20-25 | Sand (55%); Cobble (35%); Rock (5%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (5%) |
| 25-30 | 25-30 | Sand (50%); Rock (25%); Cobble (20%); Silt (5%) | No fauna observed | Green alga (<i>Spongomorpha</i> sp.) (5%) |
| 30-35 | 30-35 | Cobble (60%); Rock (20%); Sand (15%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (10%) |
| 35-40 | 35-40 | Sand (45%); Cobble (30%); Rock (20%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (40%) |
| 40-45 | 40-45 | Sand (70%); Cobble (20%); Rock (5%); Silt (5%) | Shell hash | No flora observed |
| 45-50 | 45-50 | Sand (80%); Cobble (10%); Rock (5%); Silt (5%) | No fauna observed | No flora observed |
| 50-55 | 50-55 | Sand (40%); Cobble (40%); Rock (15%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (20%) |
| 55-60 | 55-60 | Cobble (55%); Rock (35%); Sand (5%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (35%) |
| 60-65 | 60-65 | Sand (45%); Cobble (40%); Rock (10%); Silt (5%) | No fauna observed | Bladderwrack (<i>Fucus vesiculosus</i>) (15%) |
| 65-70 TT2 End | 65-70 | Sand (75%); Cobble (15%); Rock (5%); Silt (5%) | No fauna observed | No flora observed |

*A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).

Table A.5 45 m Survey – Transect TT3, 13 July, 2015

| Transect Distance (m) | Transect Tag Numbers | Substrate (Estimated % Coverage) | Macrofaunal Life Observed (Estimated Abundances*) | Macrofloral Life Observed (Estimated % Coverage) |
|-----------------------|----------------------|---|---|--|
| 0-5 TT3 Start | 0-5 | Sand (85%); Cobble (15%) | No fauna observed | Macrofloral debris (5%) |
| 5-10 | 5-10 | Sand (85%); Cobble (15%) | No fauna observed | Macrofloral debris (5%) |
| 10-15 | 10-15 | Sand (70%); Cobble (15%); Boulder (15%) | No fauna observed | Macrofloral debris (35%); Terrestrial shrubs |
| 15-20 | 15-20 | Boulder (100%) | No fauna observed | Terrestrial shrubs |
| 20-25 | 20-25 | Boulder (100%) | No fauna observed | No flora observed |
| 25-30 | 25-30 | Boulder (100%) | No fauna observed | Lichens (25%) |
| 30-35 | 30-35 | Boulder (90%); Rock (10%) | No fauna observed | Lichens (25%) |
| 35-40 | 35-40 | Boulder (35%); Cobble (35%); Rock (15%); Sand (15%) | No fauna observed | Green alga (<i>Spongomorpha</i> sp.) (5%) |
| 40-45 TT3 End | 40-45 | Sand (50%); Cobble (45%); Rock (5%) | No fauna observed | No flora observed |

*A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).

Table A.6 55 m Survey – Transect TT4, 13 July, 2015

| Transect Distance (m) | Transect Tag Numbers | Substrate (Estimated % Coverage) | Macrofaunal Life Observed (Estimated Abundances*) | Macrofloral Life Observed (Estimated % Coverage) |
|-----------------------|----------------------|--|---|--|
| 0-5 TT4 Start | 0-5 | Cobble (60%); Sand (25%); Rock (15%) | No fauna observed | No flora observed |
| 5-10 | 5-10 | Cobble (60%); Rock (15%); Gravel (15%); Sand (10%) | No fauna observed | No flora observed |
| 10-15 | 10-15 | Cobble (50%); Sand (20%); Rock (15%); Gravel (15%) | No fauna observed | No flora observed |
| 15-20 | 15-20 | Sand (60%); Cobble (25%); Rock (15%) | No fauna observed | No flora observed |
| 20-25 | 20-25 | Sand (60%); Cobble (25%); Rock (15%) | No fauna observed | No flora observed |
| 25-30 | 25-30 | Cobble (55%); Rock (25%); Sand (15%); Sand (5%) | No fauna observed | No flora observed |
| 30-35 | 30-35 | Cobble (65%); Rock (20%); Gravel (10%); Sand (5%) | No fauna observed | No flora observed |
| 35-40 | 35-40 | Cobble (55%); Rock (25%); Sand (15%); Gravel (5%) | No fauna observed | No flora observed |
| 40-45 | 40-45 | Cobble (70%); Rock (15%); Gravel (10%); Sand (5%) | No fauna observed | No flora observed |
| 45-50 | 45-50 | Cobble (70%); Rock (15%); Gravel (10%); Sand (5%) | No fauna observed | No flora observed |
| 50-55 TT4 End | 50-55 | Sand (45%); Cobble (35%); Rock (10%); Gravel (10%) | No fauna observed | No flora observed |

*A = Abundant, C = Common, O = Occasional, U = Uncommon (See below).

A = Abundant

Numerous (not quantifiable) observations made throughout the entire 5 m segment.

C = Common

Numerous (not quantifiable) observations made intermittently along the 5 m segment.

O = Occasional

Quantifiable observations made intermittently along the 5 m segment.

U = Uncommon

Quantifiable observations made infrequently along the 5 m segment.



APPENDIX B
Annotated Species List

Table B1 Annotated Species List

| Classification | Common Name | Scientific Name |
|-------------------|------------------------|-------------------------------|
| Macrofauna | | |
| Arthropoda | Northern rock barnacle | <i>Semibalanus balanoides</i> |
| Macroflora | | |
| Chlorophyta | Green alga | <i>Spongomorpha</i> sp. |
| | Green alga | <i>Enteromorpha</i> sp. |
| Phaeophyta | Soft sour weed | <i>Desmarestia viridis</i> |
| | Bladderwrack | <i>Fucus vesiculosus</i> |
| | Rockweed | <i>Ascophyllum nodosum</i> |



APPENDIX C
Photo Log

General Site Photos



Photo from base of armourstone at wharf, looking east across intertidal zone



Photo from T2 B looking west towards existing breakwater



Photo from toe of existing breakwater looking east towards T2 B



APPENDIX D

Limitations

LIMITATIONS

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:
 1. The Standard Terms and Conditions which form a part of our Professional Services Contract.
 2. The Scope of Services.
 3. Time and Budgetary limitations as described in our Contract.
 4. The Limitations stated herein.
2. The report has been prepared in accordance with generally accepted environmental study practices. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.
3. The objective of this report was solely to characterize the seabed footprint of the proposed Project area.
4. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. Amec Foster Wheeler accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.